BREEDING HABITS AND ASSOCIATED PHENOMENON IN SOME INDIAN BATS[1]

Part VIII — *Taphozous melanopogon* (Temminck) — Emballonuridae

V. M. SAPKAL AND K. G. KHAMRE[2]

Specimens of *Taphozous melanopogon* (Temminck) were collected from dungeons and passages of old discarded forts at Narnala, Chikaldhara, Mandu and Raysen. The population varies at the colony during different seasons. It has a sharply defined annual breeding cycle. Young are delivered between the last week of May and first week of June. The gestation period is about 120 to 125 days. The newly born young are 7 to 8 g in weight and are weaned when they attain a body weight of 20 g. There is a complete dominance of the right side of the female genitalia over the left, and, as a rule, ovulation occurs from the right ovary and conceptions in the right cornu. The left side of the genitalia is functional in very exceptional cases. The young do not attain sexual maturity within the first year of birth. The colony shows an even sex-ratio only during the season of copulation, whereas the males are more numerous in the colonies examined during the rest of the year. Evidently, the females migrate from these colonies during the sexually quiescent period.

INTRODUCTION

Information concerning the details of breeding habits and sex-cycle on Indian emballonurid bats is confined to a brief description of the breeding habits and ovarian cycle in *Taphozous longimanus* (Gopalakrishna 1954, 1955) and to a preliminary account of the breeding behaviour of *Taphozous melanopogon* (Khaparde 1976) inhabiting temples of Bhuvaneshwar, Orissa. Even these short accounts have revealed that there are basic differences in the breeding sexual activity of the two species which are so closely related taxonomically. Whereas, *Taphozous longimanus* (Gopalakrishna 1954, 1955) is a continuous breeder with a quick succession of pregnancies with the two horns of the female genitalia functioning alternately, *Taphozous melanopogon* (Khaparde 1976) is a restricted breeder with the right side of the genitalia being functional. Further, there appears to be differences in the breeding pattern of *Taphozous melanopogon* in different climatic and ecological situations. Hence, a detailed study has been undertaken to study the breeding habits and sexual cycle of *Taphozous melanopogon* collected from three different localities in Central India, but having nearly the same ecological conditions.

MATERIAL AND METHODS

The specimens of *Taphozous melanopogon* (Temminck) were collected from dungeons and passages of old forts at Narnala, Chikhaldara, Mandu and Raysen. All these localities are situated in the midst of dense jungle. Collection from Narnala were made so as to have one

---

[1] Accepted March 1981.

[2] Department of Zoology, Institute of Science, Nagpur-440 001.

TABLE I

SUMMARY OF THE COLLECTION DIARY

Date of Collection	Place of Collection	Males				Females							Total
		Immature		Mature	Total no. of Males	Immature			Mature			Total Number of Females	Number of Specimen
		Suck-ling	Free			Suck-ling	Free	Non-Preg-nant	Pregnant Rt. horn	Pregnant Lt. horn	Lact-ating		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6.1.78	Chikhaldara	—	—	3	3	—	1	—	—	—	—	1	4
11.1.78	,,	—	—	2	2	—	1	1	—	—	—	2	4
14.1.78	Narnala	—	8	13	21	—	6	4	—	—	—	10	31
22.1.78	,,	—	2	9	11	—	1	2	—	—	—	3	14
23.1.78	Chikhaldara	—	1	3	4	—	—	—	—	—	—	—	4
27.1.77	,,	—	—	3	3	—	—	3	2	—	—	5	8
27.1.80	Narnala	—	11	14	25	—	—	2	15	—	—	17	42
30.1.77	,,	—	—	7	7	—	—	—	11	—	—	11	18
30.1.78	Chikhaldara	—	—	2	2	—	—	—	3	—	—	3	5
5.2.78	Narnala	—	1	8	9	—	—	—	1	—	—	1	10
9.2.79	,,	—	—	4	4	—	—	3	4	—	—	7	11
10.2.79	,,	—	2	4	6	—	—	3	—	—	—	3	9
11.2.78	Chikhaldara	—	—	1	1	—	—	—	7	—	—	7	8
23.2.77	Narnala	—	1	2	3	—	—	—	3	—	—	3	6
3.3.77	Narnala	—	—	3	3	—	—	—	—	—	—	—	3
21.3.78	Chikhaldara	—	5	20	25	—	—	—	2	—	—	2	27
30.3.80	Mandu	—	2	9	11	—	—	—	13	1	—	14	25
15.4.77	,,	—	1	3	4	—	—	2	6	—	—	8	12
29.4.78	Raysen	—	3	9	12	—	—	—	18	—	—	18	30
2.5.78	Mandu	—	2	12	14	—	1	—	9	—	—	10	24
18.5.77	Narnala	—	—	8	8	—	—	—	—	—	—	3	11
29.5.77	Mandu	2	—	—	2	—	—	—	—	—	2	2	4
30.5.77	,,	—	1	7	8	—	—	—	9	—	—	9	17
15.6.78	,,	9	3	10	22	5	1	4	—	1	17	28	50

TABLE I (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
19.6.77	Narnala	—	—	11	11	—	—	—	—	—	—	—	11
1.7.77	Mandu	1	1	3	5	2	—	3	—	—	—	5	10
9.8.76	Chikhaldara	—	—	14	14	—	—	—	—	—	—	—	14
27.8.77	„	—	—	8	8	—	—	—	—	—	—	—	8
20.9.76	„	—	—	6	6	—	—	—	—	—	—	—	6
30.9.76	Mandu	—	—	5	5	—	2	2	—	—	—	4	9
1.10.77	„	—	2	10	12	—	6	5	—	—	—	11	23
4.11.76	Narnala	—	—	—	—	—	—	2	—	—	—	2	2
5.11.76	„	—	—	1	1	—	3	1	—	—	—	4	5
7.11.76	Chikhaldara	—	—	3	3	—	—	—	—	—	—	—	3
16.11.78	Narnala	—	1	16	17	—	4	5	—	—	—	9	26
17.11.76	„	—	2	5	7	—	2	3	—	—	—	5	12
14.12.76	Chikhaldara	—	—	6	6	—	3	—	—	—	—	3	9
17.12.76	Narnala	—	4	7	11	—	5	4	—	—	—	9	20
20.12.77	Chikhaldara	—	4	3	7	—	2	2	—	—	—	4	11

TABLE II

MONTH-WISE COLLECTION OF SPECIMENS

Month	Males	Females	Total
January	78	52	130
February	23	21	44
March	39	19	58
April	16	26	42
May	32	24	56
June	33	28	61
July	5	5	10
August	22	0	22
September	11	4	15
October	12	11	23
November	28	20	48
December	24	16	40
	323	226	549

collection or more representing each month. The specimens were collected only a few times from the other two localities. Since there is no difference in the breeding behaviour of the specimens in the different localities, the descriptions are common except where a special mention is made regarding specimens from a special locality.

The specimens were caught at random during the daytime with a butterfly net and brought to the laboratory alive. After noting down the significant characters of the external genitalia in the male and mammary glands in the female, the specimens were killed by chloroform and their body weights recorded by a sensitive spring balance. After fixation of the dissected genital tracts in suitable fixatives they were preserved in 70% alcohol. In the case of males, the right testis of each specimen was taken out of the preservative 70% alcohol, rolled on filter paper and quickly weighed in a Mettler balance. Although this does not give the actual weight of the testis, this gives a correct picture of the relative weights of the testes of the different specimens, since the testes of all the specimens were subjected to the same procedure.

Table I is a summary of the collection diary, and Table II gives the monthwise collection of specimens.

OBSERVATIONS

Taphozous melanopogon is a medium sized bat which lives in colonies in which the population varies during the different seasons of the year. The largest colony studied for the present report was found at the main fort of Mandu, having a population of 12,000 to 15,000 specimens. The specimens clung to the rough surfaces of the wall or were inside cracks in the walls. At Narnala also a colony of *Taphozous melanopogon* was located in an old fort, and the specimens were found in narrow dark tunnels within the walls of the fort. The colony contained about 2000 to 3000 specimens. At Chikhaldara there was a colony of 400 to 500 specimens in narrow passages of an old fort. The roost was almost empty at Narnala and Chikhaldara during April. During March and August the roost at Chikhaldara has mostly males with a very small number of females. Evidently, the specimens migrate to some other place during these months, and it appears as if the females leave the colony during certain months of the year and roost elsewhere.

Taphozous melanopogon is a medium sized bat with an adult body weight ranging from 25 to 35 g. The males have a dark brown fur on the body and are easily recognisable by their having a black beard. The gular pouch, which is so characteristic of other species of *Taphozous* is not present in *Taphozous melanopogon.*

Female genitalia:

The ovary is ellipsoidal in shape measuring 1.00 mm in length, 0.7 mm in breadth and 0.8 mm in the middle. It is attached to the mesovarium by a broad hilus and is enclosed in a complete ovarian bursa. The Fallopian tube arises from the postero-mesial aspect of the bursa, traverses along the anterior margin of the bursa curves caudally passing on the lateral side of the bursa and opens into the cranial end of the respective uterine cornu. In the nonparous females the two uterine cornua are nearly equal in length (8.0 mm) and meet caudally to form a 'V'-shaped structure. In the parous females the right uterine cornu is distinctly thicker than the left. The vagina is 14 mm long has a transverse slit-like opening.

Examination of serial sections reveal that the lumen of the uterine cornu do not become widely confluent to form an uterine body, but the lumen of each cornu continues independently as a distinct canal without the typical uterine glands, and joins its counterpart of the contralateral side only near its distal end to open by a common opening at the tip of the cervix.

Breeding Habits:

The breeding behaviour of *Taphozous melanopogon* is same in all the three localities from which the specimens were collected for the present study. Hence, the present observation are common to specimens of all three localities. Special mention of any specific locality is mentioned only where pertinent.

An examination of the collection diary and Table I reveals several interesting feature. Pregnancy, as evidenced by the presence of bulbous uterine cornu, was noticed during the period between 5th February and 30th May. With the exception of two atypical specimens, all adult females collected on 15th June had delivered their young and the uterine cornu, which bore the conceptus, had become completely involuted and had reached the normal condition. Many of the specimens were carrying well grown young at their breasts. These facts indicate that these females had delivered their young atleast 10 to 15 days before. This is further substantiated by the fact that two females collected on 29th May had delivered and were in full lactation. They carried a newly born young each at the breast. Both the young were nearly naked, had adherent eyelids and had a stump of an umbilical cord, one young weighed 7 g and the other 8 g. The average weight of a full term foetus ranged between 7 to 8 g. Evidently, they had been delivered just a few hours earlier — about 8 to 10 hours before. The rest of the specimens collected on 29th and 30th May were heavily pregnant and carried full term conceptuses which would have been delivered in a day or two. It appears that all the females in the colony, barring the two exceptional specimens collected on 15th June, delivered their young during the two weeks — the last week of May and first week of June.

Microscopic examination of the female genitalia of specimens collected during January revealed that copulation had not occurred in any female collected upto 23rd January. Two females collected on 27th January had sperms in the uterus, an early corpus luteum in the ovary and an egg in early cleavage in the ovarian part of the Fallopian tube. Most of the adult specimens collected on 30th January had either late morulae or early blastocysts. The specimens collected on 5th February had late implanted blastocysts. From this date onwards the females carried progressively advanced conceptuses until delivery during the last week of May or first week of June.

The facts indicate that *Taphozous melanopogon* has a sharply defined annual breeding cycle. Secondly, copulation is immediately followed by pregnancy, which advances progressively during the following weeks. Pregnancy was not noticed at any other period of the year.

The first batch of newly delivered young were obtained on 29th May and these, as has already been shown, might have been delivered a few hours before. The young ones collected on 1st July weighed 15 to 17 g and were free. The adult females, however, were still in lactation, and milk oozed out of the nipples when the mammary glands were pressed. No specimen in lactation was collected after this date.

From the above description of the breeding habits of *Taphozous melanopogon*, the annual life of the adult female of this species can be recognised into the following periods:

1) Period of sexual quiescence — from the middle of July to the third week of January.
2) Oestrus — copulation and fertilization during the last week of January.
3) Pregnancy — from the last week of January to first week of June.

This has been arrived at by taking into consideration that the sucklings obtained on 1st June were reasonably well grown, but not grown enough to become completely independent. The maximum weight of the young collected on that date was 17 g. On 9th August when the next collection was made, the young were free and independent, and the lowest body weight was 24 g. Looking at the rate of growth of the young it is reasonable to assume that the sucklings obtained on 1st July would be weaned by about 10th to 15th of July when they attain a body weight of about 20 g.

While the above pattern of sexual life of the female is the normal situation, there were noticed two unusual and exceptional specimens, one on 29th April and the other on 15th June. While all other pregnant specimens collected on 29th April were nearly of one stage of pregnancy, the exceptional specimen carried a conceptus which was distinctly smaller than the others. Likewise on 15th July while all other specimens had delivered their young and the uterus in these had undergone complete involution, there was one specimen which carried a full term foetus, which, judging by its size, would have delivered in a day or two. Strangely, while in all other cases the pregnancy was distinctly carried in the right uterine cornu, these two exceptional specimens carried the conceptus in the left cornu. Evidently, there is a very small number of females in the colony which conceive later than all others, and while the number of specimens exhibiting such unusual behaviour is too small to warrant any generalization, it is strikingly extraordinary that only these should be carrying the pregnancy in the left cornu. Perhaps they missed or underwent unfruitful copulation or there was an early degeneration of the ovum released from the right side, and may have induced the left ovary to release an ovum from the left ovary at a later date within the breeding season.

It is interesting to note that amongst the emballonurid bats, while *Taphozous longimanus* (Gopalakrishna 1954, 1955), *Rhychonyteris naso* (Burt and Stirtos 1961) breed throughout the year, *Taphozous georgianus* (Kitchner 1973) and *Taphozous magnis* (Al Rabaake 1968) breed once a year in a sharply defined season. *Taphozous melanopogon* resembles the latter two species in this respect. It is interesting that two closely allied species such as *Taphozous longimanus* (Gopalakrishna 1954, 1955) and *Taphozous melanopogon* living under the same climatic conditions possesses divergent breeding habits.

Number of young and symmetry of female genitalia

Among the 89 pregnant females which exhibited unquestionable pregnancy, 87 carried the conceptus in the right cornu and two in the left. The examination of the ovaries of 46 specimens carrying the conceptus in the right cornu revealed that the corpus luteum was invariably present in the ipsilateral ovary. The examination of the ovaries of the two exceptional specimens carrying pregnancy in the left cornu showed that in both these cases the ovary of the left side had released the ovum as revealed by the presence of a corpus luteum. The ovary of the nonfunctional side showed a typical anoestrus condition in all the species.

The genitalia of all the females collected on 27th and 30th January were examined histologically since copulation took place during this period. Out of 36 such females 31 had released the ovum from the right ovary, 3 had a pre-ovulatory follicle each in the right ovary and the other two were immature females. These facts show that the right ovary is the normal functional ovary in this species and the embryo implants in the ipsilateral cornu. It is in very exceptional cases that the left ovary releases the ovum and the embryo implants in the left cornu. The exceptional situations occur only in the very few specimens in which there is delayed copulation and ovulation. Hence, these specimens conceive at least 2 to 3 weeks later than the other specimens. Evidently, the right side of the female genitalia is nearly completely physiologically dominant in this species. The left side becomes functional only under very exceptional conditions.

Duration of pregnancy:

The collection diary and Table I indicates that pregnancy in progressively advanced stages occur between 5th February and 30th May. Two specimens each carrying a young weighing 7 g were obtained on 29th May 1977. Both were nearly naked on the belly, reddish in colour and had still a small umbilical stump which had not withered. Their eyelids had not yet opened. This, taken along with the fact that the weight of the full term foetus (average of 7 foetuses obtained from specimens collected on 30th May 1977), indicates that the two sucking young ones collected on May 1977 must have been delivered a few hours before.

Histological examination of the specimens collected in January showed that the earliest date when a fertilised egg was noticed was 27th January, and during the following days the specimens contained progressively advanced embryos either in the Fallopian tube or in the uterus. Implanted blastocysts were present in specimens collected on 5th and 9th February.

From the above data it is evident that the duration of pregnancy in *Taphozous melanopogon* is 120 to 125 days allowing a couple of days on either side — the date when fertilisation was observed (27th January) and the date when the first batch of young ones were collected (May, 29).

Growth and maturity:

The collection diary and Table I reveals some interesting data on the growth and age of maturity in *Taphozous melanopogon.* Except the specimens, which are attached to the breast of the mother during the suckling period, it is not possible to determine the maturity or otherwise in this species in the free specimens on the basis of the size and body weight. By the time the young ones leaves the mother, it is nearly of the same size as the mother and very soon attains adult body weight. Thus, after about three months after birth the immature animals cannot be distinguished from the adults on the basis of the size of the body. However, the size of the testis in male and the size and nature of the mammary nipples and the fact whether the uterus contains an embryo or not in the female are valid criteria to determine sexual maturity or otherwise. On the basis of these criteria it is evident that during the sexual season there are many immature males in the colony. Likewise there are many nonpregnant females in the colony during the season of pregnancy. Since this species breeds only once a year in a sharply defined period, since there are immature specimens in the colony during the breeding period, it is evident that the animals of this species do not attain sexual maturity within the year of their birth. Since, the young ones are delivered late in May or early in June, since the reproductive season commences in the last week of January and since the animals do not attain sexual maturity within the year of their birth, the animals are atleast 21 months of age (from the end of May to the end of January of the year after the year of birth) when they come to sexual activity, and the female is atleast 24 months before she delivers her first young.

Consequently, during the beginning of the breeding season the colony has atleast three kinds of individuals: (i) the immature ones, (ii) those which would be experiencing their first sexual season and (iii) those which had experienced sexual activity atleast once before. The data at present do not warrant a definite conclusion regarding the possible longevity of the species. The animal has to produce atleast 3 young ones for the preservation of the species allowing for possible early mortality. This would mean that this specimen should live atleast for 50 months to produce 3 young and wean the last one. Brosset (1962 a), who made observations on this species, noticed the dead bodies of many young ones during suckling periods. He reported that atleast 30 per cent of the young ones born in the colony each year are thus lost before they are weaned. If this factor is added to the normal expected minimum maturity, then each female may lose

1/3rd the number she delivers. Hence, she should produce atleast four young in her life time to perpetuate the species. Brosset's (1962a), and the present observations indicate that the colony actually increases in size and after reaching a certain maximum, the spillover of the population migrate to form another colony. This demands that atleast five young should be produced by the female in her life time. Hence, the female should have a minimum longevity of atleast 74 months allowing for the weaning of the 5th young born to the female.

Sex-ratio:

The collection record and Table II indicates that out of the total 549 specimens collected of all ages there were 323 males and 226 females. This gives a male dominant uneven sex-ratio of 5 to 3% males in the population. Earlier observations of Abdulali (1949) also revealed an uneven male dominant sex-ratio for this species and also for *Hipposideros lankadiva.* In all other bats, in which the sex-ratio has been studied so far, there is a preponderance of the female (Gopalakrishna 1974). The present study on *Taphozous melanopogon* has revealed some extremely interesting data. Although specimens have been collected throughout the year and from different (three) localities and although in all the localities the total number of males collected was more than the females, it appears it would be fallacious to draw conclusion on the data thus obtained in the case of *Taphozous melanopogon.* This caution is indicated by the following facts. The number of sucklings obtained is too small to be of any statistical significance. The collection record during the season of copulation (between January 16 and January 30) shows that among the mature animals there were 26 males against 31 females giving nearly even sex-ratio with the females being slightly more than the males. During the entire period of sexual activity from copulation to delivery, there were 111 males and 111 females. Evidently, the imbalanced sex-ratio as revealed by the total collection is due to the difference in number of the adult males to adult females during the nonsexual season (from June to the last week of the following January) when collection contained 149 mature males and only 13 mature females. This shows that except during the sexual season the males and females live segregated. It is also interesting to note that, while the males remain in the original colony, the majority of females migrate to some other place.

It is difficult to determine the accurate sex-ratio of colonial bats, which tend to live in sexually segregated colonies during different seasons of the year, unless it is possible to establish their migratory routes and the place where the emigrant bats roost. Hence, the sex-ratio of this species as revealed by the collection record is not valid. Perhaps Abdulali (1949) also drew conclusion on the sex-ratio of this species on the basis of only a few collections and from one or two male dominant colonies. A survey of many colonies of this species within its migratory distance is necessary for understanding the exact sex-ratio in this species.

ACKNOWLEDGEMENT

We express our deep gratitude to Dr. A. Gopalakrishna, Director, Institute of Science, Nagpur for his guidance throughout the progress of this work.

REFERENCES

ABDULALI, H. (1949): Sex ratio in Indian bats. *J. Bombay nat. Hist. Soc. 48*: 423-428.

AL RABAAKE, K. (1968): Notes on the biology of the tomb bat, *Taphozous nudiventris magnus* v. Wettstein 1913, in Iraq. *Saugetierk Milt., 16*(1): 21-26.

BROSSET, A. (1962): The bats of Central and Western India. Part I. *J. Bombay. nat. Hist. Soc., 59* (1): 36-42.

BURT, W. H. AND STRITON, R. A. (1961): The mammals of El Salvador. *Misc. Publ. Mus. Zool. Uni. Michigon., 117*: 1-69.

GOPALAKRISHNA, A. (1954): Breeding habits of the Indian sheath-tailed bat. *Taphozous longimanus* (Hardwicke). *Curr. Sci., 23*: 60-61.

——————— (1955): Observations on the breeding habits and ovarian cycle in the Indian sheath-tailed bat, *Taphozous longimanus* (Hardwicke). *Proc. Nat. Inst. Sci.* India., *21*: 29-41.

KHAPARDE, M. S. (1976): Notes on the breeding habits of the Indian sheath-tailed bat, *Taphozous melanopogon* (Temminck). *J. Bombay nat. Hist. Soc., 73*(2): 321-324.

KITCHNER, D. J. (1973): Reproduction in the common sheath-tailed bat, *Taphozous georgianus* (Thomas) (Microchiroptera: Emballonuridae) in Western Australia. *J. Zool., 21*: 375-89.